Observations on the biology of the Bleating Tree Frog *Litoria dentata* (Anura: Hylidae), made on a single population in Sydney, New South Wales

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ABSTRACT

In a sample of 49 mature *Litoria dentata* from a single Sydney population collected over two consecutive nights in early autumn, males were significantly more common than females. Males and females had similar average weights, but females averaged larger in snout-vent length. Females had smaller fat bodies more frequently than did males. Amplexus was axillary. Females contained from at least 512 to 3 054 eggs, and averaged 1 868.3 eggs in unambiguously complete clutches. There was no relationship between either clutch size or weight, and female snout-vent length or weight. Relative clutch mass ranged from 0.34 to 0.63, and averaged 0.41. The phalangeal formula for the manus and pes was 2.2.3.3/2.2.3.4.3 for all specimens. The left femur was longer than the right femur both in terms of number of animals and in mean length.

INTRODUCTION

The Bleating Tree Frog *Litoria dentata* (Fig. 1), is a small brownish frog distributed along the east coast of Australia from southeastern Queensland to just south of Sydney (Cogger 1993). Although the frog is locally common, there is little information on its basic biology. We report here on several aspects of the species' biology gleaned from examination of a large number of specimens from one breeding population collected over two nights in late spring from a site near the demographic centre of the greater Sydney area. We examined sex ratio, sexual size dimorphism, clutch size, clutch size in relation to female size, relative clutch mass, and variation in the number of phalanges.

MATERIALS AND METHODS

A total of 49 specimens was collected at random in and around an ephemeral breeding pool (Fig. 2) at the Newington Armaments Depot, Homebush, Sydney on the nights of the 3rd and 4th of March 1995 (Australian Museum R 147039–147087). The shallow breeding depression was in an area of open grass and casuarina which was bordered on the west by a brackish water wetland, and on the east by a bitumen road and a eucalypt woodland on a slight rise. The breeding area is within a few tens of metres from a toxic waste site and easily within reach of surface runoff and groundwater seepage from that site. Furthermore, the water in the brackish water wetland just to the west is considered unfit for human contact (Fig. 2). The breeding site was seemingly inappropriate with regard to reliability of the standing water as the depression had dried a few days after the second visit, and large amounts of spawn was left stranded. Specimens were collected at random with the exception of two amplecting pairs. All specimens were killed in a chlorotone solution within two days of capture, fixed in a "spread eagle" position in 10% formaldehyde solution, and then transferred to 65% alcohol for permanent storage.

Freshly euthanased intact frogs (24 males and 14 females), and the extracted ovaries of females ($\underline{n}$ = 14), were weighed to the nearest 0.1 g. Weights of all females reported here are without eggs (ovaries removed). The preserved frogs were x-rayed for details of the skeleton, measured snout to anus with dial callipers to the nearest 0.1 mm, and dissected for sex, maturity, and clutch size (only mature eggs with dark and pale hemispheres counted). The left and right femurs of each specimen were measured on the x-ray plates to the nearest 0.05 mm.

One of the amplecting females (AM R 147055) had a very small clutch when dissected (513 eggs) and may have partially spawned prior to collection. Also, spawn was discovered in the collecting bag holding a further five females (AM R 147074–147078). The clutch data for all six of these females has been excluded where their use would lead to ambiguity in the analysis.

The 0.05, 0.01, and 0.001 levels of significance are indicated by *, **, and ***.

Figure 1. Litoria dentata from the ephemeral breeding pool at the Newington Armaments Depot where the frogs for this study were collected.

RESULTS

The results of the study were as follows. The sex ratio in the sample was 33 males and 16 females, a significant bias in favour of males ($\chi^2 = 5.89^*$, df = 1).

All the specimens were mature. In weight, males ranged 2.91 to 4.68 g (mean = 3.84, sd = 0.45, $\underline{n}$ = 24), and females 3.29 to 4.81 g (mean = 4.06, sd = 0.45, $\underline{n}$ = 14), with no significant difference between the sexes (t = 1.52, df = 36, P = 0.08). In snout-vent length, males ranged 36.1 to 42.6 mm (mean = 39.6, sd = 1.65, $\underline{n}$ = 33), and females 38.3 to 45.5 mm (mean = 42.1, sd = 1.94, $\underline{n}$ = 16), with females being significantly larger (t = 4.67***, df = 47).

Amplexus in both amplecting pairs was axillary.

Every female contained ovarian eggs with obvious dark and light hemispheres. Clutch size ranged from at least 513 to at least 3 054 ($\underline{n}$ = 14) for all clutches and from 1 469 to 2 501 for unambiguously complete clutches (mean = 1 868.3, sd = 375.01, $\underline{n}$ = 10).

There was no significant regression of either clutch size or clutch weight on either female snout-vent length (r^2 = 0.00, P = 0.96, $\underline{n}$ = 10, and r^2 = 0.11, P = 0.36, $\underline{n}$ = 10) or weight (r^2 = 0.16, P = 0.29, $\underline{n}$ = 9, and r^2 = 0.17, P = 0.26, $\underline{n}$ = 9).

Relative clutch mass (weight of clutch/weight of female), a measure of the "load" the gravid female must carry prior to egg deposition, ranged in the unambiguously complete clutches from 0.34 to 0.63 (mean = 0.41, sd = 0.09, $\underline{n}$ = 9). There was no significant regression of RCM on female snout-vent length (r^2 = 0.03, P = 0.64, $\underline{n}$ = 9), but there was a just significant negative regression of RCM on female weight ($r^2 = 0.45^*$, $\underline{n}$ = 9).

Large, obvious fat bodies were observed in 26 males and two females, and no or only small fat bodies were observed in seven males and 14 females. The occurrence of large fat bodies is significantly more common in males than in females, or conversely, no or only small fat bodies were more common in females than males (χ^2 = 14.00***, df = 1).

The phalangeal formula for every manus was 2.2.3.3 and for every pes 2.2.3.4.3 ($\underline{n}$ = 49), i.e., there was no variation in phalangeal formula.

There was a significant difference between the lengths of the left and right femurs, with the left femur being longer more often than the right (χ^2 = 10.52, df = 1), and with the left averaging longer than the right (left = 15.39 mm, sd = 0.87 and right = 15.09 mm, sd = 0.77, t = 5.64***, df = 48).

DISCUSSION

The early autumn breeding date reported here (3–4 March) is later in the activity season than the only other breeding dates

Figure 2. The ephemeral breeding pool at the Newington Armaments Depot where the frogs for this study were collected. Date of photo: 3 September 1996.

known for the species: December (Morgan and Buttemer 1996), 5 January (Harrison 1922), and 21 January (van de Mortel and Buttemer 1996).

The frogs were collected at random, and not with regard to calling males, which in the event were so loud as to make orientation on a single individual difficult. Therefore, the strong bias toward males in this sample would appear to have a biological significance. As in other amphibian breeding aggregations, this male bias may be due to males staying in such aggregations longer than females (Duellman and Trueb 1986).

The larger mean snout-vent length in females (42.1 mm) than in males (39.6 mm) seen in our Sydney population is similar to the size dimorphism reported in 10 amplecting pairs from Helensburgh just south of Sydney (mean snout-vent length of females 44.0 mm and of males 40.8 mm, t = 4.0***) (van de Mortel and Buttemer 1996). Larger average snout-vent length in females appears to be the general trend in frogs without male combat (Shine 1979). Male combat has not been reported in *Litoria dentata* or any other species of Australian hylid (Tyler 1989). Females may be larger than males in order to accommodate the larger volume of their mature ovaries in comparison to the males' testes. The fact that female *L. dentata* average larger in snout-vent length than males but are no heavier is probably explained by the females having smaller fat bodies more often than males (below).

The axillary amplexus observed in the two coupling pairs is typical for hylid tree frogs (Tyler 1989).

The clutch size of 1 469 to at least 3 054 reported here for mature ovarian eggs is relatively large compared to the only other report of clutch size in this species, i.e., from 238 to 1 881 (mean = 756, n = 8) for spawned egg masses (van de Mortel and Buttemer 1996). An explanation for this discrepancy may be that not all the mature eggs are laid in a single spawning. The clutch size reported here for *Litoria dentata* is also high compared to other Australian hylids (Tyler 1989). The significance of this, if any, is unclear. Perhaps it is due to limited information for other species.

The lack of a significant intraspecific regression of clutch size on female snout-vent length is not unusual in frogs (Crump 1974). The relationship between clutch weight, and either female snout-vent length or weight is not often explored in frogs, probably due to the difficulty of obtaining weights of fresh material. However, the lack of a relationship between clutch weight, and both female snout-vent length and weight in *Litoria dentata* is not surprising given the lack of relationship between clutch size and female snout-vent length.

Relative clutch mass is not commonly reported in frogs, again perhaps because it involves weights. However, it is interesting to reflect that just before spawning, female *Litoria dentata* are carrying eggs masses which are between 34 and 63% of their own body weight. What the consequences of these loads are for survivorship are unclear.

The fact that females tended to have smaller fat bodies more often than did males is consistent with the notion that females may be using the materials in their fat bodies to produce their eggs.

The lack of any variation in the number of phalanges in either the front or rear foot is unusual even for frogs from pristine or relatively uncontaminated habitats (Read and Tyler 1990, 1994; Ferraro and Burgin 1993; Greer and Byrne 1994). It is of increased interest in this instance due to the soil and ground water contamination thought to characterize the general area.

A possible difference between the length of the left and right femurs has not been examined in other frogs. However, the limbs of other vertebrates often show a significant difference between the lengths of the two limbs (Palmer 1996), and frogs may prove to be similar when more cases are examined.

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